College of Optical Sciences
THE UNIVERSITY OF ARIZONA®

Many-particle theory of all-optical polarization switching in semiconductor quantum wells

I. Rumyantsev, N.H. Kwong, and R. Binder

College of Optical Sciences and Department of Physics
The University of Arizona

E. J. Gansen and A. L. Smirl

Laboratory for Photonics and Quantum Electronics
The University of Iowa

Supported by **ONR, DARPA, JSOP, COEDIP**

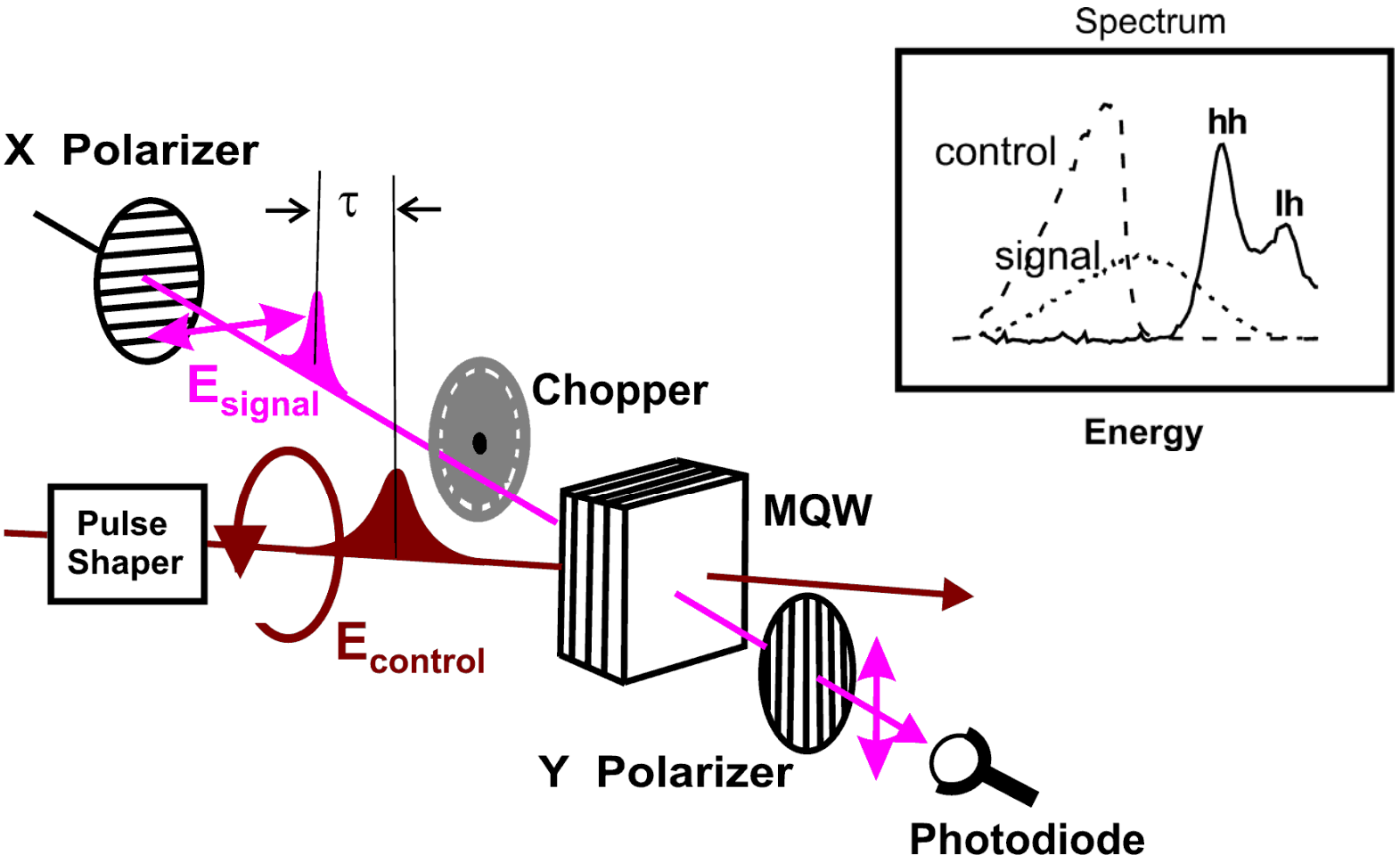
All optical polarization switch: developed at Univ. Iowa (2002)

Characteristics:
- ultrafast (sub-ps)
- high contrast ratio (200:1)
- not yet room temperature (T=100)
- planar fabrication
- isotropic material

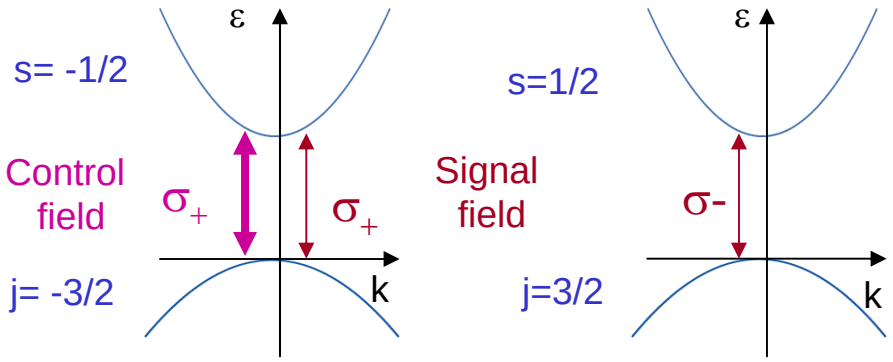
Operation:
- based on selective excitation of spin states

Theoretical issues:
- understanding of switching process with predictive theory
- identification of main many-particle process
- study of parametric dependencies of switch
- prediction of possible future optimization

Experimental Scheme



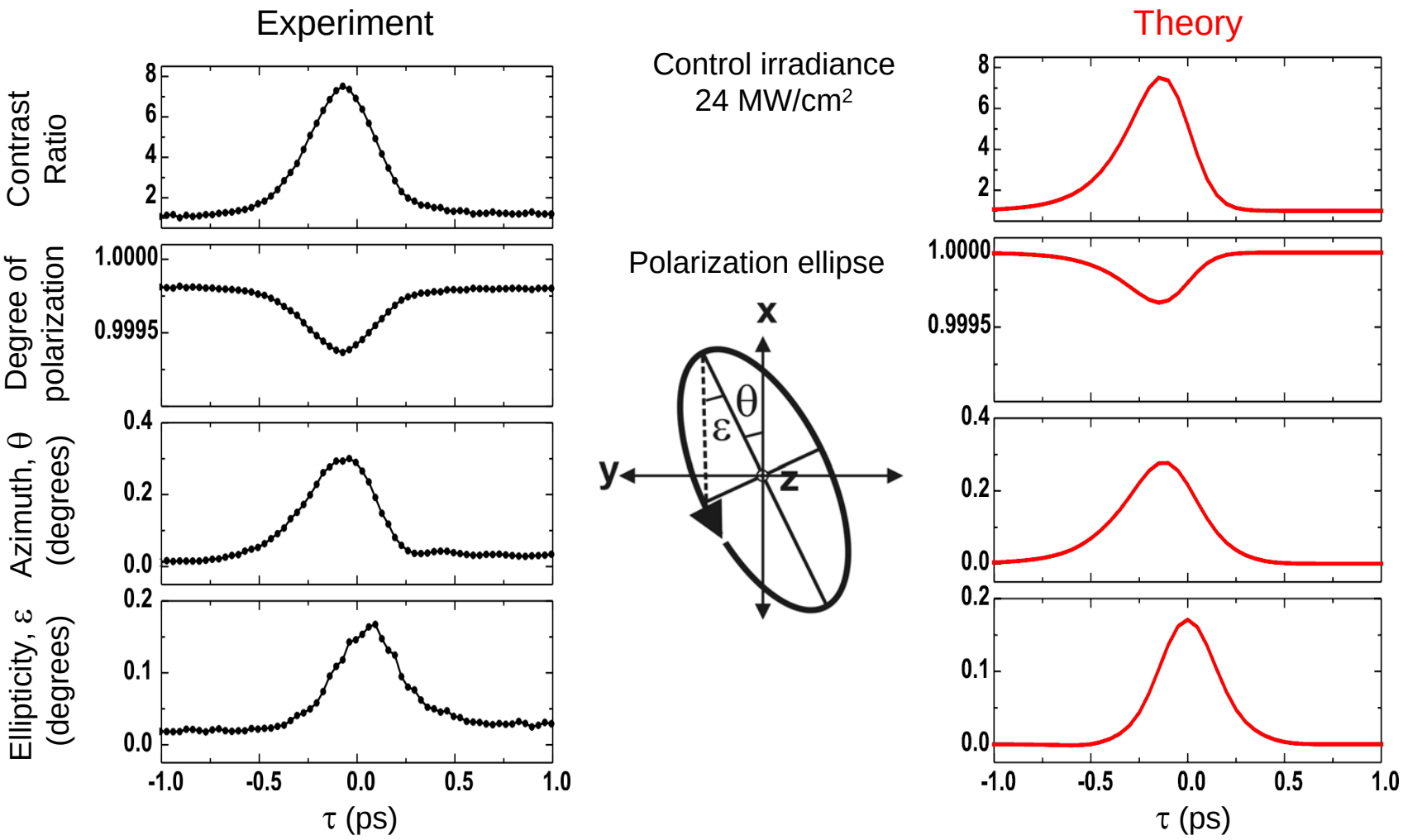
Band structure & selection rules



X-polarized signal field: equal-strength σ+ and σ- transition (no rotation)

"+" polarized control field ⇨ unequal σ+ and σ- transitions
⇨ elliptical polarization of signal output

Time-integrated signal



Rumyantsev, Kwong, Binder, Gansen, Smirl, Phys. Rev. B 69, 235329 (2004)